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SHRINKAGE LOSSES AND GRADE CHANGES IN WHEAT STORED AT KANSAS BIN SITES

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Agricultural Marketing Service

Marketing Research Division

in Cooperation with

Kansas State University of Agriculture and Applied Science

PREFACE

In recent years research personnel at Kansas State University of Agriculture and Applied Science have been studying numerous aspects of costs relating to short- and long-term storage of wheat. Previous publications have provided extensive information on important fixed and variable costs. In the spring of 1955, a project was initiated to determine the size and extent of the costs of shrinkage and quality changes in stored wheat, two costs about which there was a definite lack of knowledge.

This report is an analysis of these costs for storage of wheat in Commodity Credit Corporation bin sites. The size and extent of these costs of shrinkage and quality losses in country elevators are summarized in a publication designated AMS-291, issued January 1959.

Funds for this study were made available by the United States Department of Agriculture through a Research and Marketing Act contract with the Agricultural Experiment Station of Kansas State University of Agriculture and Applied Science.

The authors wish to acknowledge the assistance and cooperation of the personnel of the County and State Agricultural Stabilization and Conservation offices in obtaining the extensive data for the study.

Acknowledgment is made to William C. Dachtler, formerly with the Agricultural Marketing Service, now with the Agricultural Research Service, and V. John Brensike of the Agricultural Marketing Service, Department of Agriculture, and to John H. McCoy, Associate Professor, and Leonard W. Schruben, Professor, Department of Agricultural Economics, Kansas State University, for general direction in the planning and completion of the study.

This study is part of a broad program of research designed to improve the marketing of farm products.

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August 1959

SUMMARY

The objective of this study was to determine the importance of total shrinkage and grade changes in the storage of wheat.

The average losses in the net value of wheat from these causes during long period storage are shown to be quite small.

These losses during approximately 24 months of storage in Kansas bin sites of the Commodity Credit Corporation amounted to an average of 1.25 cents per bushel, assuming constant prices. About 1.11 cents of the loss in value was due to shrinkage. The residual loss of 0.14 cent resulted from the combined influence of grade changes and the removal of screenings. Grade changes resulted in an increase in value of 0.19 cent per bushel, and removal of screenings caused a loss of 0.33 cent per bushel.

Annual losses in net value averaged 0.62 cent per bushel for the 2-year period. Shrinkage losses accounted for about 0.55 cent of this amount for this period.

These average losses were determined from an analysis of 2.5 million bushels of 1952, 1953, and 1954 wheat stored in 53 Government bin sites in Kansas which were emptied during the course of the survey. The total value of these losses was based upon an assumed value of $2 per bushel for No. 1 wheat and CCC discount rates for the different grades. Sales of screenings were valued at actual sales values.

Ten bin sites were selected at random for more detailed analysis. Bins at four of these sites were emptied during the study and disclosed similar losses in net value. Factors which could possibly influence shrinkage and grade changes such as the type and capacity of the bin, insect infestation, moisture from external sources, use of insecticide, and turning operations also are summarized for these bin sites.

Gross or physical shrinkage also was analyzed and tended to average 0.28 percent of the incoming weight. This also shows the relatively small level of shrinkage losses during a long period of storage.

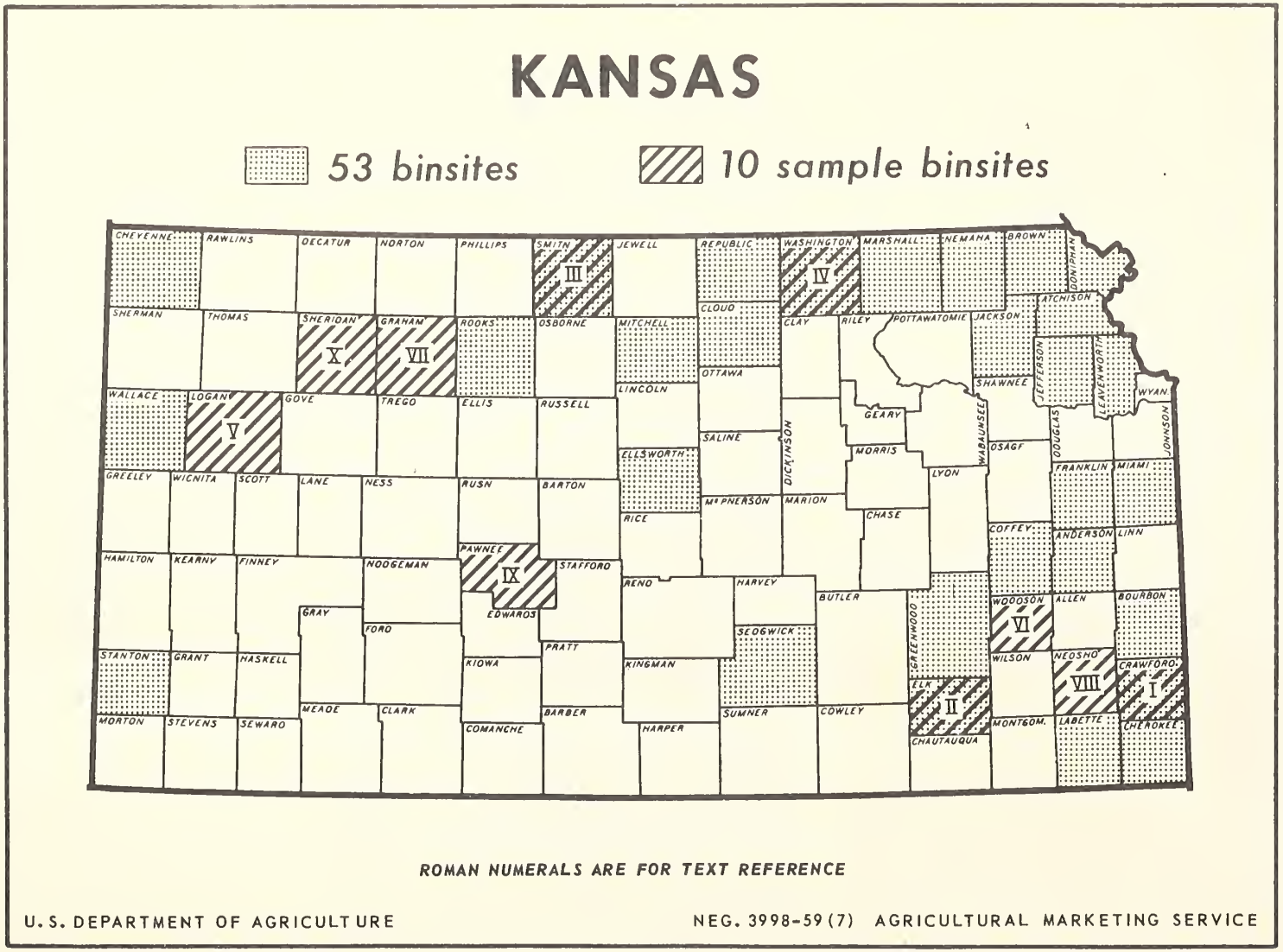

Figure 1.--Location of counties containing the sample bin sites in Kansas which had been emptied of wheat in storage from the 1952, 1953, 1954, and 1955 crops. (The term "bin site" designates all the bins in a county where numerous bins are available to hold Government-purchased grain and are considered by the County Stabilization and Conservation Office as an operating bin site.)

SHRINKAGE LOSSES AND GRADE CHANGES IN WHEAT STORED IN BIN SITES IN KANSAS

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The objective of this study was to determine the shrinkage and grade changes of wheat while in storage at CCC bin sites in Kansas. The wheat analyzed in this study was part of the 1952, 1953, and 1954 wheat crops. Shrinkage and grade changes in this wheat were analyzed during an average storage period of a little more than two years.

METHODOLOGY

Ten bin sites were selected at random in the spring of 1955 for a detailed study of shrinkage losses and grade changes in the wheat--five from the eastern section and five from the western half of Kansas (fig. 1). Wheat at the sample bin sites, in general, was representative of all wheat stored in Kansas from these same crops.

The bins of three of these bin sites were completely emptied during the observation. Shrinkage was computed for an additional bin site, although one of the bins at this site was not emptied. Observations at this site were sufficient to yield accurate estimates of shrinkage and grade changes. Accurate data on shrinkage losses and value changes were not available for the wheat stored in the remaining six bin sites because of the substantial amounts of wheat remaining in storage as of April 30, 1957.

The Kansas State Agricultural Stabilization and Conservation Office supplied records concerning the weights and grades of all deliveries to and shipments from 49 additional bin sites containing wheat from these crop years. The bins in each of these sites had been completely emptied of wheat.

These additional data on the 49 bin sites, plus the 4 bin sites from the original sample of 10, expanded the study sample to 53 bin sites located in 29 Kansas counties.

Shrinkage data were obtained for all 53 sites. 1/ Grade information was not available for 1 bin site, so information on value changes was tabulated only for wheat stored in 52 bin sites located in 28 counties (fig. 1).

1/ All wheat stored in the 53 bin sites was produced during 1952, 1953, and 1954, except for 10,700 bushels of 1955 wheat delivered to one bin site. This 1955 wheat was unavoidably mixed with wheat from the other crop years during shipment from the site, which necessitated its inclusion in the analysis. This small amount of wheat was corrected for in the analysis and did not influence the results of the shrinkage and grade analyses.

Most of the data for the sample bin sites were collected from county Agricultural Stabilization and Conservation office records and supplemented from the State ASC office files. Records were examined to tabulate (1) the net quantity, grade, and estimated assumed value of all wheat delivered to the bin site, (2) the net weight and grade of all wheat removed from the bin sites, (3) the amount and sale value of all screenings removed, (4) the estimated quantity and grade measurements of all wheat remaining in storage as of April 30, 1957, and (5) the management practices performed at each bin of wheat.

Official grade observations were made for all wheat delivered to and shipped from the sample bin sites, and these formed the basis for computations of value changes included in this report. Grade analyses made on the grain in each bin included test weight; moisture; dockage; heat sprouting; insect damage; rodent and bird contamination; shrunken or broken kernels; and others.

Moisture content at the beginning of the storage period averaged 10.2 percent for the 1/3 million bushels of wheat stored in the five sample bin sites in eastern Kansas and 9.7 percent for the 1½ million bushels stored in the five sample bin sites in the western half of the State. The average moisture content of the wheat in the individual bin sites ranged from 10.9 percent for bin site VIII to 9.5 percent at bin site VII. The average moisture content for all 10 bin sites was 9.8 percent. All of the wheat at the sample bin sites was well below the maximum moisture content levels which are generally considered safe for storage.

Enough dockage was present at the beginning of the storage period to show in the grade designation as 1-, 2-, or 3-percent dockage in about 1 out of 35 of the individual lots of wheat received at the five sample eastern bin sites and in about 1 out of 20 of the individual lots of wheat received at the five sample western bin sites. The grade designation for the remaining lots of wheat received at the sample bin sites showed "zero" dockage.

CHANGES IN NET VALUE

For determining changes in net value, the "net" amount was used for bushels delivered to the bin site and for bushels which were shipped from the bin site. Inventory records maintained by the ASC office personnel show the "net" bushels of wheat in storage on any given data at each bin site. Each receipt of wheat is tested for the amount of dockage and compensation is made for the "net" bushels after the amount of dockage expressed in whole numbers is deducted from the total gross weight. Records of receipts thus represent the actual number of bushels for which wheat producers were reimbursed.

Shipments of grain from the bin sites are shown on a similar basis. If the official grade observations for all deliveries to and shipments from a bin site indicated no dockage, the bushel amounts were the same for value change calculations as for computing shrinkage. Thus if a lot of wheat was designated as containing dockage of 1, 2, or 3 percent, value changes were computed on the basis of the "net" bushels delivered to and shipped from the

site. For example, a 2,000 bushel delivery or shipment with a 1-percent dockage designation would be figured as only 1,980 bushels delivered or shipped. Value changes were based on this 1,980 bushel figure since this would be the amount actually paid for or sold.

While accurate information was available concerning the actual number of bushels and the official grade of all wheat delivered to and shipped from the bin sites included in this study, computation of changes in value required the use of assumed prices in order to analyze the influence of shrinkage and grade changes rather than price changes.

All wheat grading No. 1 at delivery or at shipment was valued at $2 per bushel, and all other grades were valued at $2 less the appropriate discount. The rate of $2 per bushel for No. 1 wheat was the average price received by Kansas farmers for 1956 crop wheat. The discount rates used were those used by the Commodity Credit Corporation in settlement for farm-stored wheat. The appropriate discounts are based on the value of No. 1 Hard Red Winter Wheat, the primary class of wheat raised in Kansas (table 1).

Table 1.--Commodity Credit Corporation discount rates for Hard Red winter wheat of different grades

Grade	Discount from No. 1 wheat	Discount from next highest grade
	Cents per bushel	Cents per bushel
No. 1	0	0
No. 2	1	1
No. 3	3	2
No. 4	6	3
No. 5	9	3

The discount for wheat which was designated as sample grade was computed on the basis of the individual settlement rate. This rate is determined on the basis of an inspection of the wheat sample and the offered price set by the Commodity Stabilization Service office in Kansas City, Mo.

The total change in value during the storage period was computed by determining the difference between the value of wheat received and the value of wheat shipped plus the value of screenings sold.

The value of the wheat received was found by applying the respective assumed values to the "net" total weight of each grade of wheat received. The value of wheat shipped was determined in the same manner. Each bushel lost was valued at $2. The change in value due to shrinkage loss was subtracted from the total change in value.

The residual amount of the value change resulted primarily from the net effect of changes in grade and removal of damaged grain and screenings.

The method of computation is further explained in the following example. Wheat valued at $145,556.66 was delivered to one bin site. Wheat valued at $144,279.91 was shipped from that bin site. In addition, $35.40 worth of screenings were sold for feed. Thus the total change in value was $1,241.35. The value of shrinkage at $2 per bushel was subtracted from this figure. The net shrinkage for this purpose was recorded as 355.01 bushels. 2/ Subtraction of the value of shrinkage from the total change in value resulted in a net loss of $531 due to grade changes and removal of screenings.

Changes in Value at 52 Bin Sites

The value of the 2,527,508 bushels of wheat delivered to the 52 bin sites was $5,010,493. The total loss in value amounted to $31,561, of which $28,019 was due to shrinkage and $3,542 to grade changes and removal of screenings.

This represented an average loss in value of 1.25 cents per bushel placed in storage--1.11 cents due to shrinkage and 0.14 cent to the combined influence of grade changes and removal of screenings.

The average length of storage for the wheat in the 52 bin sites was slightly over 24 months before the bins were emptied. On this basis the average annual loss in value was approximately 0.623 cent per bushel. Shrinkage losses comprised 0.553 cent per bushel of this annual loss.

Five of the 52 bin sites had an increase in total value during the period of storage and 17 showed a net gain in value due to the combined effect of grade changes and removal of screenings.

The grade changes actually resulted in a net increase in value of a little over 0.19 cent per bushel. The removal of screenings caused a loss of 0.33 cent per bushel stored during the storage period.

Two factors contributed to this increase in grade: (1) The discount basis used for valuation of wheat resulted in some cases in an increased average value when wheat of different grades was mixed. For example, this may have resulted if approximately equal amounts of No. 1 (valued at $2) and No. 3 wheat (valued at $1.97) were delivered to a bin site. If these were mixed at shipment, the wheat removed from the bin site may have graded No. 2 (valued at $1.99). (2) Mixing wheat of different test weights in some cases helped upgrade the commodity in storage.

The loss in value (other than shrinkage) was a result of the removal of screenings which were sold for a much lower price than their original cost. The 7,140 bushels of screenings actually were sold for only about 77 1/3 cents per bushel. This implies that the material removed was spoiled or damaged grain and that the difference between the salvage value and the original value of the wheat represented a decrease in value. However, to the extent that these screenings were dockage the sale of screenings at a salvage value results in an increase in value.

2/ This differs slightly from the 364.08 bushels obtained at this bin site to compute the percentage of gross shrinkage.

The largest loss for any single bin site due to the combined effect of grade changes and removal of screenings was a loss of $1,583 on wheat originally valued at $270,347 because 470 bushels of screenings which were removed sold for only $59 and the amount of sample grade wheat which was valued at only $1.92 was increased.

The largest increase in value for any single bin site due to the combined effect of grade changes and removal of screenings was a gain in value of $568. This was the result of improvement in grade of 9,973 bushels of No. 4 wheat and 1,542 bushels of No. 5 wheat. The data indicate that 11,515 bushels were shipped out of the bin site as No. 2 wheat. On this basis the net gain in grade would be valued at $572. This was the reason for the rather large improvement in value observed for this bin site.

The net loss due to grade changes and removal of screenings for five bin sites located in the western part of the State was 0.08 cent per bushel for the 188,973 bushels delivered (table 2). The annual loss in value due to grade changes and removal of screenings was 0.04 cent per bushel for wheat stored in western Kansas and 0.07 cent per bushel in the eastern part of the State.

Shrinkage losses at the bin sites were valued at 0.55 cent per bushel per storage year. The loss in value due to grade changes and removal of screenings was only 0.07 cent per bushel per year. Shrinkage losses thus were nearly eight times as large as the losses due to grade changes and the removal of screenings.

Table 2.--Changes in value due to grade changes and removal of screenings for wheat stored in 52 bin sites, by area

Area	Bin sites	Quantity stored 1/	Loss in value	Loss per bushel stored	Average length of storage period	Annual loss per bushel stored
	Number	Bushels	Dollars	Cents	Months	Cents
Eastern Kansas ...	47	2,338,535	3,388	0.14	23.86	0.07
Western Kansas ...	5	188,973	154	.08	26.59	.04
Total	52	2,527,508	3,542	.14	24.06	.07

1/ Value changes were based on "net" bushels of wheat after dockage is removed.

Changes in Value at 4 Bin Sites

The four sample bin sites which were emptied during the period of observation contained 267,966 bushels of wheat valued at nearly $533,000. The total loss in value during the period of observation was $3,006, of which $2,951 was due to shrinkage and $55 to grade changes and removal of screenings (table 3).

The total loss in value averaged 1.12 cents per bushel--a loss of 1.10 cents from shrinkage and 0.02 cent from grade changes and removal of screenings.

Shrinkage losses averaged 0.5 cent per bushel annually, and grade changes and removal of screenings averaged 0.01 cent annually, making an average annual total loss in value of 0.51 cent per bushel (table 4). The change in value per bushel stored ranged from a gain of 0.59 cent per bushel for wheat stored an average of 29 months at bin site No. II to a loss of 0.283 cent per bushel for wheat stored an average of 23 months at bin site No. I. The annual average ranged from a gain of 0.24 cent per bushel to a loss of .15 cent per bushel at these same two bin sites (table 4).

Table 4.--Annual average gain (+) or loss (-) in value due to grade changes and removal of screenings at four sample bin sites in Kansas

Bin site	Total bushels stored 1/	Gain or loss per bushel stored	Average months in storage	Annual average gain or loss per bushel
	Number	Cents	Number	Cents
I	87,722	-.2827	23	-.1475
II	24,623	+.5893	29	+.2438
III	40,997	-.0565	29	-.0234
IV	114,624	+.0617	30	+.0247
Total	267,966	-.0207	26½	-.0094

1/ Value changes were based on "net" bushels of wheat after dockage is removed.

Grade changes which occurred resulted in an increase in the value of the wheat. The average value at removal from the sites was greater than at delivery. Mixing of the wheat undoubtedly contributed much to this increase in value due to grade changes.

The portion of the $55 loss in value, which was not due to causes other than shrinkage, occurred primarily because of the sale or dumping of screenings. When the material removed consisted of damaged or spoiled grain, the difference between the salvage value and the original value of the wheat resulted in loss of value. When the screenings removed consisted of dockage for which no compensation was made, any salvage value would result in an increase in value.

Table 3.--Total changes in value of wheat stored at the four sample bin sites that were nearly emptied during period of observation

Bin site	Value of receipts	Value of shipments	Value of screenings sold	Value of wheat remaining in site	Total loss in value	Value of shrinkage on net basis	Gain or loss in value due to grade changes and removal of screenings
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
I	175,322	174,528	43	-	751	503	-248
II	48,717	48,259	-	-	458	603	+145
III	81,557	80,901	-	-	656	633	-23
IV	227,009	220,797	291	4,780	1,141	1,212	+71
Total	532,605	524,485	334	4,780	3,006	2,951	-55

GROSS SHRINKAGE ESTIMATES

Since net shrinkage estimates may be subject to error due to (1) the use of samples from which the percentage of dockage is determined, and (2) the disregarding of fractions of a percent of dockage found in those samples, 3/ an analysis was also made of the gross or physical shrinkage which occurred at each bin site. The use of gross or physical shrinkage estimates involves an assumption that the rate of shrinkage in the wheat and dockage are about the same. In wheat containing only 3 percent dockage, 4/ the maximum found in this survey, a different rate of shrinkage in the dockage could have had comparatively little effect on the rate of shrinkage in the total mass.

Gross or physical shrinkage was computed by determining the difference between the original gross weight placed in the bins and the gross weight removed at the end of the storage period. 5/

Shrinkage at 53 Bin Sites

Gross shrinkage of reserve stocks stored at the 53 sample bin sites totaled 14,048 bushels. This overall shrinkage amounted to 0.55 percent of the total delivery of 2,570,820 bushels. The weighted average length of time the wheat was in storage in these 53 bin sites was 23.84 months. Thus, this amounts to an annual average shrinkage of 0.28 percent.

Considerable variation was noted among the individual bin site shrinkage losses. The lowest shrinkage observed was an actual positive shrinkage of 73.33 bushels or a 0.45 percent gain in weight. The largest rate of shrinkage observed was 895 bushels on a total delivery of 42,269 bushels or a shrinkage of 2.12 percent.

Wheat stored in the 47 bin sites in the eastern part of Kansas had a higher average gross shrinkage than for the wheat stored in the 6 bin sites in the western part of the State. The eastern bin sites contained just slightly over 10 times as much wheat as those located in western Kansas, but the total shrinkage was nearly 16 times greater (table 5).

3/ The Official Grain Standards of the United States, June 1957, state: The percentage of dockage when equal to 1 percent or more, shall be stated in terms of whole percent, and when less than 1 percent shall not be stated. A fraction of a percent shall be disregarded.

4/ See footnote 3.

5/ This corresponds to net or market shrinkage only when "zero dock" wheat is considered.

Table 5.--Shrinkage in wheat stored in bin sites located in eastern and western Kansas 1/

Area	Receipts	Shrinkage	Percentage of shrinkage
	Bushels	Bushels	Percent
Eastern Kansas ...	2,338,535	13,217	0.5652
Western Kansas ...	232,285	831	.3579
Total	2,570,820	2/14,048	.5465

1/ Shrinkage observations were based on "gross" weight of the wheat.
2/ If valued at a loss of $2 per bushel, this equals $28,096 or slightly more than the net shrinkage estimate (table 2).

Summarization of the shrinkage data by county removes some of the variations in percentage of shrinkage which was noted between individual bin sites. Eight bin sites containing nearly 457,000 bushels were located in one county. The observed shrinkage of 0.57 percent in this county is only slightly greater than the overall average for the 53 sites. Nearly 18 percent of the total wheat stored in the 53 bin sites was stored in this county. The percent shrinkage for the entire period of storage for the 12 counties containing more than one bin site ranged from a low of 0.30 percent to a high of 0.73 percent.

Shrinkage per 1,000 bushels per storage year, by counties, ranged from a low of 3/4 bushel per storage year to a high of $14\frac{1}{2}$ bushels per storage year.

Six bin sites had less than 10,000 bushels of wheat delivered for storage. Shrinkage at these bin sites averaged nearly $7\frac{1}{2}$ bushels per 1,000 bushels in storage. The six bin sites which had over 100,000 bushels in storage had a physical shrinkage of 5.7 bushels per 1,000 bushels stored, considerably below that observed at the smaller bin sites. This seems to indicate that percent of shrinkage has a tendency to decrease as the number of bushels stored increases, although no statistical significance of this was noted.

Shrinkage at 4 Bin Sites

Bin sites No. I, II, and III were observed to have had a physical shrinkage of 0.30, 1.24, and 0.70 percent, respectively (table 6). It is interesting to note that bin site No. II, which had the least amount of wheat in storage, actually showed the largest shrinkage. Even more significant is the fact that the net bushel loss was larger than that for either of the other two sites.

Table 6.--Shrinkage observations for the sample bin sites that were emptied during period of observation 1/

Bin site	Receipts	Shipments	Loss	Shrinkage	Average months in storage
	Bushels	Bushels	Bushels	Percent	Number
I	87,779	87,514	265	0.30	23
II	24,626	24,321	305	1.24	29
III	41,027	40,740	287	.70	29
Subtotal	153,432	152,575	857	.56	25½
IV	114,649	114,018	631	.55	30
Total	268,081	266,593	1,488	.55	26½

1/ Shrinkage observations were based on the "gross" weight of the wheat.

The average shrinkage observed for the three sample bin sites which were emptied was 0.56 percent. This is slightly over one-half of one percent for the average storage period of 25½ months.

The wheat stored at bin site No. IV was almost entirely shipped out. Only one bin of wheat remained in storage as of April 30, 1957. It was believed that measurements were close enough to warrant satisfactory shrinkage computation. Therefore, included in table 6 is the shrinkage at this bin site which amounted to 631 bushels or 0.55 percent on the 114,649 bushels which were delivered to the site. This estimate includes the 1955 wheat which was not kept separate from the 3 years' wheat under observation when the grain was shipped out.

The average storage period for the four bin sites, 26½ months, results in an average annual shrinkage loss of 0.25 percent of the weight of the wheat during this period.

DESCRIPTION OF OPERATIONS AT 10 SAMPLE BIN SITES

It is often contended that the following factors influence the shrinkage losses and grade changes at bin sites: 6/

6/ Possibly due to the small number of bin sites emptied during the study, no statistically significant relationships were discovered between these factors and the net value or gross shrinkage losses.

1. Type and capacity of bins
2. Insect infestations
3. Moisture from external sources
4. Fumigations
5. Frequency of use of insecticides
6. Turning operations

Type and Capacity of Bins

Most of the bins used at the bin sites included in this study were round steel bins with a rated capacity of about 3,250 bushels. For example, in the 10 sample bin sites all but 18 bins were of this type. Two of these 18 were flat steel construction and 16 were rectangular wooden structures.

Insect Infestation

Records were maintained for each time a bin was inspected and insects were found. Inspection was usually made by probing the wheat mass at various depths. The samples obtained were then checked for presence of insects. Often only one or two insects would be found in six to eight probe samples. The bin would then be recorded as having contained insects, but was classed in most cases as only a very light infestation. Very few severe infestations were found and action was taken immediately to control those that were observed.

In only 17 percent of the bins containing 1952 wheat were insects reported more than five times during the storage period. In 28 percent of the bins of 1953 wheat and 22 percent of the bins of the 1954 wheat, insects were reported more than five times. The bins containing 1953 and 1954 wheat thus were reported to have contained insects more often than bins containing 1952 wheat, even though the wheat had been in storage a shorter length of time. A total of 126, or 22 percent, of the bins were reported to have contained insects at more than five inspections.

Moisture from External Sources

Bin site supervisors indicated that snow blowing into the bins at the eaves or at the ventilator cap was the primary cause of moisture in the bins. All bin supervisors followed the practice of entering the bins and removing the snow shortly after a storm. Entry of small amounts of snow which was promptly removed was felt to be of little significance in causing damage to the grain.

A total of 165, or 28 percent, of the bins was recorded as having had some moisture from external sources at some time during the storage period.

Fumigation

For the 1952 wheat 55 percent of the bins were fumigated five or more times during the period of storage. Approximately three-fourths of the bins were fumigated four or more times. These figures are heavily influenced by the observations at one bin site since 45 percent of the bins containing 1952 wheat were located at that bin site and 98 percent of them were fumigated four or more times.

Half the bins containing 1953 wheat and 38 percent of the bins in which 1954 wheat was stored were fumigated five or more times during the storage period. At one bin site all of the bins containing 1952, 1953, and 1954 wheat were fumigated four or more times.

The rate of fumigation (gallons per bin) differed considerably from time to time. Some fumigations were at the rate of 2 to 3 gallons for 3,000 bushels, while other fumigations were at the rate of 10 gallons or even more for 3,000 bushels of wheat in a bin. The fumigation rate depended upon the severity of insect infestation.

In general, the bin site supervisors in the counties under observation tended to follow the practice of fumigating once a year during the storage period with additional fumigations only when it was necessary to control insects.

Use of Insecticides

Reports indicate that many of the bins were sprayed with a residual insecticide prior to being filled with wheat. In addition, DDT, commercial mill sprays, and other chemicals for controlling of insects have been used. In an attempt to control the dermestid beetle, commercial mill sprays were used at some bin sites. A clear type of oil also was used to control meal moth infestations. No insecticide was used in slightly over 43 percent of the bins, while 23 percent of the bins were observed to have been sprayed with mill spray, DDT, or oil, five or more times. Insecticides were used much more often on the bins of wheat at bin site IX than was found to be true in the other counties.

Turning Operations

A total of 363 of the bins of wheat was turned during the period of observation. Eighteen were turned twice and one bin was turned three times. Approximately 71 percent of the bins containing 1952 wheat were turned. For the 1953 wheat 45 percent and for the 1954 wheat 60 percent of the bins were turned.

Proportionally more wheat stored in the western counties was turned than was true in the eastern counties. This was especially true for the 1952 wheat. At two sites (bin sites Nos. V and IX) all the wheat stored in round steel bins was turned. Other western Kansas sites turned most of the 1952 wheat, primarily to condition the grain and for inspection purposes.

Most of the screenings sold and dumped from these 10 sites were obtained during turning operations or at delivery or shipment of the wheat.